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MODULAR I-BEAM

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MODULAR I-BEAM

FIELD OF THE INVENTION

The present invention related generally to steel beams and, more particularly, to a modular steel beam that can be assembled in place.

BACKGROUND OF THE INVENTION

Trends in residential building call for large, open spaces and high ceilings, creating a demand for structural members that provide higher strength and greater stability over longer spans than conventional lumber. Engineered lumber, such as wood I-beams, laminated veneer lumber (LVL), and glulam beams, are often used in place of conventional lumber in residential designs where high loads and/or long spans are present. Engineered lumber, however, is more expensive than conventional lumber and, therefore, increases the cost of construction. Also, engineered lumber is frequently custom-designed for a particular application, creating a logistical problem for the builder, who must coordinate the design, manufacture, and transportation of the engineered lumber to the work site.

Structural steel, such as steel trusses and I-beams, provide another alternative to conventional lumber in residential designs where high loads and/or long spans are present. Steel members are relatively inexpensive and come in a wide variety of sizes and shapes which are readily available. However, large steel members can be difficult to handle due to their size and weight. Oftentimes, special equipment such as cranes or other lifting equipment is needed to put steel members in place.

Accordingly, there is still a need for structural members for residential construction that provide greater strength and stability over long spans than conventional lumber, yet are relatively inexpensive, readily available, and easily handled on the work site.

BRIEF SUMMARY OF THE INVENTION

The present invention is a modular steel I-beam that can be assembled in place at a construction site. In one embodiment, the modular I-beam comprises a plurality of nested steel channels fastened to a central beam made of wood to form an I-beam. The builder chooses the size and number of steel channels to fasten to the central beam depending upon the requirements of a particular application. The steel channels may be combined in a variety of ways, allowing the builder to effectively build a custom designed I-beam for a given application.

In one exemplary embodiment of the invention, the nested channels are provided in paired sets. Each paired set comprises an outer channel and an inner channel. The outer and inner channels each comprise two flanges connected by a central web. The outer ends of the flanges are angled inwardly toward a midline of the channel. In the preferred embodiment, the flanges of the inner channel angle outwardly such that the flanges of the inner channel bear against the flanges of the outer channel. This arrangement makes the inner channel self-aligning with respect to the outer channel and facilitates assembly at the construction site. The inner channel effectively snaps into the outer channel and the angle on the outer end of the flanges for the outer channel helps retain the inner channel in a nested position.

An I-beam may be constructed by arranging two paired channels on each side of a central beam. Additional paired channels can then be nested inside the first set of paired channels. The nesting of paired channels may continue until a beam with the desired strength characteristics is formed.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of the modular I-beam of the present invention.

Figure 1A is a cross-sectional view of the moldular I-beam having a closure channel extending around one side of the beam.

Figure 2 is an exploded cross-section of a channel pair used to make the modular I-beam of the present invention.

Figures 3A-3C illustrate how the modular I-beam of the present invention is assembled in place.

Figure 4 is a side elevational view of a single channel pair used to make the modular I-beam.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and particularly to Figure 1, the modular I-beam of the present invention is shown therein and indicated generally by the numeral 10. The modular I-beam 10 comprises a plurality of nested channels 20, 40, disposed in back-to-back relation to one another and fastened to a central beam 12 made of wood or other suitable materials. It should be pointed out that the nested channels 20, 40 can themselves be disposed in back-to-back relationship. That is, in some designs, such as where an all steel construction is desired, the central beam 12 would be unnecessary. The nested channels 20, 40 are grouped into two sets. One set of nested channels 20, 40 forms one side of the modular I-beam and the other set of nested channels 20, 40 forms the opposite side of the modular I-beam 10. In the embodiment shown in Figure 1, the nested channels 20, 40 are secured to the central beam 12 by threaded fasteners 14 that passed through aligned openings in the nested channels 20, 40. The threaded fasteners 14 may, for example, comprise a conventional bolt and nut. Other types of fasteners,

such as nails, rivets, or screws, may be used to secure the nested channels 20, 40 to the central beam 12.

Each set of nested channels 20, 40 comprises one or more channel pairs 50. In Figure 1, there are three channel pairs 50 within each set of nested channels. The number of channel pairs 50 needed will depend on the strength requirements of a particular application. In general, a modular I-beam constructed in accordance with the present invention may have one or more channel pairs 50.

Figure 2 is an exploded cross-sectional view of a single channel pair 50. The channel pair 50 comprises an outer channel 20 and an inner channel 40. Both channels 20, 40 are formed from a particular gauge steel, such as a 10-gauge steel. The outer channel 20 comprises a top flange 22 and a bottom flange 24 connected together by a central web 26. The top flange 22 and bottom flange 24 may include an outer end portion 28 that angles inwardly toward a midline of the channel 20 at an angle of approximately 15°. The angled end portions 28 provide greater strength and rigidity to the I-beam 10. While the top flange 22 and bottom flange 24 both include angled end portions 28 in the disclosed embodiment, such is not required. Alternatively, only the top flange 22 could include an angled end portion 28 and, in any case, the angle may vary.

Channel 40 also comprises a top flange 42 and bottom flange 44 connected by a central web 46. The top flange 42 and bottom flange 44, angle outwardly at a slight angle away from the center line of the channel 40. In the disclosed embodiment, the top flange 42 and bottom flanges 44 form an angle of approximately 90° with the central web 46. Top flange 42 and bottom flange 44 may include an outer end portion 48 that angles inwardly toward the midline of the channel 40. Outer end portions 48 form an angle of approximately 60° to the top and bottom

flanges 42 and 44. While the top flange 42 and bottom flange 42 both include angled end portions 48, such is not required. Alternatively, only the top flange 42 could include an angled end portion 48.

In the preferred embodiment of the invention, the inner channel 40 is sized to fit into the outer channel 20 in a nested fashion with the top and bottom flanges 42 and 44 of the inner channel 40 bearing against the top and bottom flanges 22 and 24 of the outer channel 20 to help align the inner channel 40 with respect to the outer channel 20. The inner channel 40 and outer channel 20 include a series of aligned openings 52. The function of the aligned openings 52 is to receive fasteners, such as threaded fasteners, nails, or screws. The aligned openings 52 may be of varying size. For example, some of the aligned openings 52 may be designed to receive nails used to tack the channels 20, 40 to the central beam 12 during assembly of the beam 10, as will be hereinafter described. Some of the aligned openings 52 may be larger and adapted to receive the threaded fasteners 14 which provide the primary securing force for holding the parts of the modular I-beam 10 together.

Channels 20, 40 may come in a wide variety of sizes. Table 1 below gives dimensions for three exemplary channel pairs 50. The dimensions A, B, C, and D are labeled in Figure 2.

Table 1 - Dimensions for Representative Channel Pairs			
Outer Channel 20		Inner Channel 40	
A	B	C	D
13.25	3.5	12.597	3.375
11.25	3.5	10.597	3.375
9.25	3.5	8.597	3.375

Using the present invention, a modular I-beam meeting desired size and strength requirements can be assembled on site. To assemble a modular I-beam 10, the central beam 12 is first put in place and secured by any suitable means. Once the central beam 12 is in place, channel members 20, 40 may be secured to the central beam 12 one at a time as shown in Figures 3A-3C. In Figure 3A, the outer channel 20 of a first channel pair 50 is attached on each side of the central beam 12. The outer channel 20 may be held in place temporarily by nails that pass through openings 52 in the channel 20 into the central beam 12. Once the outer channel 20 is secured to the central beam 12, the matching inner channel 40 is inserted into the outer channel 20 and tacked in place using nails or screws. Additional channel pairs 50, each one getting progressively smaller than the previous one, may be added to the modular I-beam 10 until the desired strength requirement is met. Figures 3B and 3C show the addition of second and third channel pairs 50 respectively to the modular I-beam 10. Each time a channel 20, 40 is added to the modular I-beam 10, it may be tacked in place using nails or screws. Once all the desired channels 20, 40 are put in place, they may be secured in place by threaded fasteners 14 as shown in Figure 1.

It is contemplated that the channel members 20, 40 according to the present invention will come in certain standard lengths. For long spans, it may be necessary to put channel members 20, 40 end-to-end to construct a modular I-beam 10 for a long span. When constructing a modular I-beam 10 for a long span, it may be desirable to offset the inner channel joints and the outer channel joints in each channel pair 50. This technique of offsetting joints is shown in Figure 4, which shows a side elevational view of a single channel pair 50. As shown in Figure 4, the joints 34 between adjacent channel members 20 is offset with respect to the joints

54 of adjacent inner channel members 40. Offsetting joints 34 and 54 in this manner provide greater strength and stability.

Figure 1A illustrates an alternative design for the modular I-beam 10. A closure channel, indicated generally by the numeral 60, extends around one side of the beam 10 and basically encloses the sets of nested channels disposed on one side of the beam. It should be appreciated, that the closure panel 60 can be utilized on either side of the beam and in some cases may even be employed on both sides of the beam. While closure channel 60 may be constructed of various materials, it is contemplated that the closure channel 60 would be constructed of steel. As illustrated in figure 1A, the closure 60 includes a face plate 62, and upper and lower plate 64 and 66. Plate 62, 64 and 66 can be connected by various means such as weldment or by bolt assemblies. To secure the closure channel 60 to the beam 10, the upper and lower plate 64 and 66 are provided with spaced apart pre-drilled holes. A series of nails 68 extend downwardly through the drilled holes into the central beam 12. If the central beam 12 is not present, the upper and lower plate 64 and 66 can be screwed to the top and bottom flanges of one of the nested channels.

In the case of the modular I-beam 10 shown in figure 1A, joists can be connected in a flush condition directly to the face plate 64. This design offers advantages and conveniences in certain situations. For example, by connecting joists flush to the beam 10, the beam 10 and joists lie in substantially the same plane, thus obviating the necessity of boxing in and finishing around the beam, and in the case of ceiling joists, avoiding the beam being disposed below the ceiling. In the case of the design of figure 1, where there is no closure channel 60, the beam 10 is utilized in what is referred to as a drop header condition. Here the joists simply set on top of the beam 10.

In the embodiment illustrated herein, the modular I-beam 10 is shown to include a central beam 12 made of wood or other suitable material. It should be appreciated that the modular I-beam 10 of the present invention may simply comprise a plurality of nested channels that are secured in back-to-back relationship without the presence of a central beam being interposed between the channels. Further, the channels have been described as being nested together. This means one channel within another and does not imply that the flange portions of any nested pair must engage each other.

The present invention may, of course, be carried out in other specific ways than those herein set forth without departing from the scope and the essential characteristics of the invention. The present embodiments are therefore to be construed in all aspects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.